

Project Fabrication and Characterization of Nanoelectronic Devices and Circuits
Owner Jan-David Fischbach **Start Date** 14.05.2021
Page 1/5 **Revised Date** July 29, 2021
Samples 6 SOI samples, 6 bulk samples

Session 1 - 12.5.21

Determination of RIE etch parameters

Nr.	Description	Tool	Operator	Date	Duration	Parameters
1.	start material					1.5 cm × 1.5 cm bulk Si sample pieces diced from 12" Si wafer
2.	Lithography	Resist wet bench, MA4 IHT, Fume Hood	JD Fischbach	12.5.21	30:00	HMDS coat @ °C for 19 Steps (including dehydration during heatup) Spin Coat AZ5214e: 3 sec @ 1000 rpm, 1 min @ 4000 rpm 90 sec soft-bake @ 95 °C exposure 7.5 sec @ 15 mW/cm ² and 405 nm development: 50 sec in MIF726
3.	RIE Etch	Cobra Oxford	JD Fischbach	12.5.21	1:00:00	1. Venting load lock 2. DESCUM (Oxygen plasma) for sharper etch edges: 20 sccm O ₂ for 2 min @ 45°C with 10 W HF power 3. SF ₆ : p=15 mTorr; HF=20 W; SF ₆ : 37.5 sccm; O ₂ : 11 sccm 4. Resist strip: 1.5 kW ICP for 8 min 50 sccm O ₂
4.	Profilometry	Dektak	JD Fischbach	12.5.21	30:00	stylus force: ? scan speed: ? range: 6 μm results see figure 1

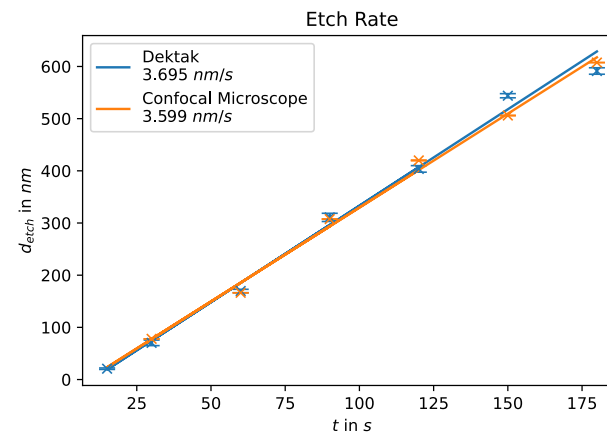


Figure 1: Estimation of the etch rate from dektak and confocal microscope measurements

Session 2 - 19.5.21

Determination of Deal Grove model parameters

Nr.	Description	Tool	Operator	Date	Duration	Parameters
1.	start material					1.5 cm × 1.5 cm bulk Si sample pieces from last session
2.	Pre clean	ZMNT R001	Jan-David Fischbach	19.5.21	30 min	Acetone for 10 min @ 120°C Isopropanol for 10 min @ 120°C DI rinse for 10 min @ Roomtemperature
3.	RCA clean	ZMNT R001	Jan-David Fischbach	19.5.21	2 h	piranha solution: 150 ml H_2SO_4 + 50 ml H_2O_2 , 10 min DI water rinse 10 min HF (1%) till surface is hydrophobic 100...150 ml ca. 20 sec DI water rinse 5 min SC-1: 125 ml H_2O + 25 ml $NH_3(aq)$ + 25 ml H_2O_2 : 10 min DI water rinse 10 min HF (1%) till surface is hydrophobic 100...150 ml ca. 20 sec DI water rinse 5 min SC-2: 150 ml H_2O + 25 ml HCl + 25 ml H_2O_2 : 10 min DI water rinse 10 min
4.	RTA	RTA	Jan-David Fischbach	19.5.21	-	vent load lock, insert, pump down (2 stages (2nd stage: Turbo molecular pump)) 2000sscm O_2 , 1000°C, 50°C/s ramp, 90 sec and 150 sec @ 1000°C
5.	Ellipsometry	Ellipsometer	Jan-David Fischbach	19.5.21	-	See results in figure 2.

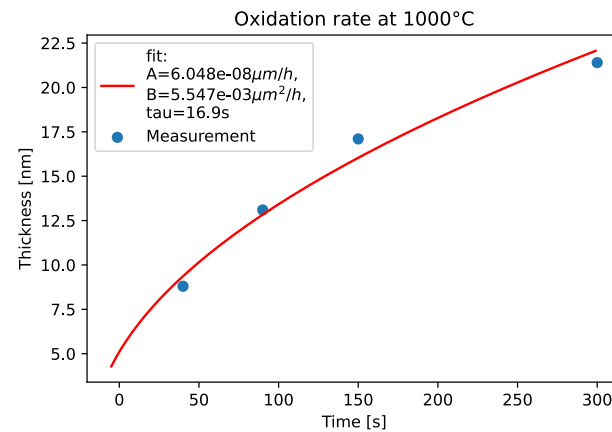


Figure 2: Estimation of the Deal Grove model parameters

Session 3: Active area (mesa) definition of SOI samples

Nr.	Description	Tool	Date	Duration	Parameters
1.	HMDS Coating	HMDS coater	02.06.2021	5-8 min	135°C
2.	Photoresist Coating	spin coater	02.06.2021	4 sec 60 sec	1000 rpm 3000rpm
3.	Soft bake	hot plate	02.06.2021	90 sec	95°C
4.	Optical lithography	laser scanner	02.06.2021	14 min	405 nm 30% transmission 1505 mJ/cm ² 25.3 °C 4step-752 mJ/cm ²
5.	Post exposure bake	hot plate	02.06.2021	90 sec	125 °C
6.	Development	wet bench	02.06.2021	45 sec	Developer MIF AZ726 rinse with DI water
7.	Reactive ion etching	ICP-RIE (PlasmaPro 100 cobra)	02.06.2021	100 sec	15mTor 20W
7.	Reactive ion etching from another group	ICP-RIE	02.06.2021	120 sec	Descum Pressure:10 mTor HF:10W O ₂ :20 sccm He Backing:10 sccm Temp:45°C
7.	Reactive ion etching	ICP-RIE (PlasmaPro 100 cobra)	02.06.2021	100sec, 30sec	Si-etch, SF6/O2 Etchrate: 3.7nm/s Target depth: 340nm/80nm Pressure:15mTor HF:20W ICP:0W SF6:37.5sccm O ₂ :11 sccm He Backing:10sccm, Temp:45°C

Session 4: Formation of gate dielectrics

Nr.	Description	Tool	Date	Duration	Parameters
1.	RCA clean		09.06.2021		Piranha etching piranha solution: 150 ml H ₂ SO ₄ + 50 ml H ₂ O ₂ , 10 min DI water rinse 10 min 1 % HF till surface is hydrophobic, 20 sec DI water rinse 10 min SC-1: 125 ml H ₂ O + 25 ml NH ₄ OH + 25 ml H ₂ O ₂ : 10 min DI water rinse 10 min 1 % HF till surface is hydrophobic, 20 sec DI water rinse 10 min SC-2: 150 ml H ₂ O + 25 ml HCl + 25 ml H ₂ O ₂ : 10 min DI water rinse 10 min
2.	Oxidation		09.06.2021	130 sec	To obtain 15 nm d _{ox}

Session 5: Image reversal process: nickel contact structuring (lift-off)

Nr.	Description	Tool	Date	Duration	Parameters
1.	dehydration bake	HMDS coater	18.06.2021	5 min	120°C
2.	HMDS Coating (HMDS_01)	HMDS coater	18.06.2021		135°C
3.	Spin coat AZ5214e	spin coater	18.06.2021		3 s @1000 rpm; 30 s @3000 rpm
4.	Soft Bake	hot plate	18.06.2021	1:30 min	95°C
5.	Exposure	MA4 IHT	18.06.2021	2 sec	15 mW/cm ² 405 nm
6.	reverse Bake	hot plate	18.06.2021	2 min	115°C
7.	flood exposure	MA4 IHT	18.06.2021	15 sec	15 mW/cm ² 405 nm
8.	development	Wet bench	18.06.2021	36 sec	AZ726 MIF

Session 6: Lift-off, silicidation and definition of gate electrode

Nr.	Description	Tool	Date	Duration	Parameters
1.	Lift-off of aluminium layer		24.06.2021		Bathe with Acetone and Propanol Flush with syringe Dehydration 150°C
2.	Primer coating (HDMS)		24.06.2021	3 sec 1 min	1000rpm 6000rpm
3.	Soft bake	hot plate	24.06.2021	90sec	95°C
4.	Photoresist coating (AZ S214B)	spin coater	24.06.2021	3 sec 60 sec	1000rpm 3000rpm
5.	Soft bake	hot plate	24.06.2021	90sec	95°C
6.	Edges removal with q-tips dipped in acetone	q-tip		24.06.2021	
7.	Overlay Alignment		24.06.2021		
8.	Short Exposure		24.06.2021	2 sec	Hg lamp 405 nm
9.	Reverse bake		24.06.2021	2min	120°C
10.	Flood Exposure		24.06.2021	15sec	
11.	Development	wet bench	24.06.2021	36 sec	MIF 726 DI water rinse for a few minutes

Session 7: Lift-off gate; ALD and Image reversal process: program gates

Nr.	Description	Tool	Date	Duration	Parameters
1.	lift-off	Beaker + Hotplate	02.07.21	5-10 min	90W 150°C pipette to speed up process
2.	ald	cluster tool	02.07.21		Trimethylaluminium = $Al(CH_3)_3$, Ar purge, $H_2O = Al_2O_3$ Each cycle (0.1nm), total 15 nm 150 cycles 1-100-ALD-Heating up- no wafer 2- 101-ALD- Al2O3 Plasma 300 C 60 sscm O2. 80 sscm Ar Tot: 21 min 40 sec @300C 150 Cycle 607 steps
3.	dehydration bake	HMDS coater	02.07.21	5 min	120°C
4.	Ti prime	HMDS coater	02.07.21		6000 rpm then 90 sec @95°C
5.	Spin coat AZ5214e	spin coater	02.07.21		3 s @1000 rpm; 30 s @3000 rpm
6.	Soft Bake	hot plate	02.07.21	1:30 min	95°C
7.	Exposure	MA4 IHT	02.07.21	2 sec	15 mW/cm ² 405 nm
8.	reverse Bake	hot plate	02.07.21	2 min	115°C
9.	flood exposure	MA4 IHT	02.07.21	15 sec	15 mW/cm ² 405 nm
10.	development	Wet bench	02.07.21	36 sec	AZ726 MIF

Session 9: Device characterization